Animal Bones from Anglo-Scandinavian York

By T.P. O'Connor

Department of Archaeology, University of York

Introduction

This chapter provides an overview of the current state of knowledge regarding vertebrate animals in and around York in the Anglo-Scandinavian period. The great majority of the available evidence derives from 16–22 Coppergate (*AY* 15/3), with smaller amounts of data from a number of excavations around the city. The aim is not to describe the data at length, but to review the information inferred from those data under several thematic headings. Examination of the material from Coppergate began as the excavation neared its end, early in the 1980s. At that time, our knowledge of urban zooarchaeology in Britain rested on just a few major studies (e.g. Exeter, Maltby 1979; Southampton, Bourdillon and Coy 1980; Baynards Castle, London, Armitage 1977), and little or nothing was known about Anglo-Scandinavian husbandry. The intervening 30 years has seen the publication of many substantial assemblages from 8th- to 15th-century urban contexts across northern Europe (e.g. Birka, Ericson et al. 1988; Ribe, Hatting 1991; Waterford, McCormick 1997; Lübeck, Rheingans and Reichstein 1991; Compiègne, Yvinec 1997). With that increasing information has come some shift in emphasis from data such as the relative abundance of different taxa and changes through time, to more thematic questions of supply and demand, and the value of animal bones in discussions on the emergence of towns and their associated social structures (e.g. Bourdillon 1994; O'Connnor 1994; Crabtree 1990). This review therefore revisits previously published material, and incorporates additional data in a synthesis of evidence from York as a whole, and in regional comparisons. Practical methods are not discussed at length here: they are detailed by site in the appropriate fascicules of *AY* 15/1–5, and reviewed in *AY* 19/2.

Materials

Excavations at 16–22 Coppergate (1976–81.7) generated an enormous archive of animal bones, of which an estimated 50% was from, broadly, Anglo-Scandinavian deposits. The great majority of that archive was retrieved by hand-collection during excavation, with a much smaller, though still significant, quantity retrieved by the bulk-sieving of sediments on 1mm mesh, followed by sorting of the >2mm fraction. Work on the bones began in parallel with studies of the pottery and other dating evidence, and the analysis of the stratigraphic record. Accordingly, the first published work was based on a selection of the better-dated and larger assemblages (*AY* 15/3). Subsequently, the larger remaining assemblages from Anglo-Scandinavian deposits were assessed and recorded. The strategy of recovering some bones by hand-collection and some by sieving became the standard for subsequent YAT excavations in York (*AY* 19/2, 98–112).

Material from 1–9 Micklegate (1988–89.17) was recovered in particularly difficult circumstances, from surface deposits and pit fills associated with Anglo-Scandinavian post-and-wicker structures. The remains of small vertebrates from the pit fills were the subject of a special taphonomic study (Piper and O'Connor 2001). Although the Micklegate assemblage is quite small, preservation is very good, and the close association with structures makes this an important assemblage. Anglo-Scandinavian deposits were sampled during excavations at 9 St Saviourgate (1995.434), with particularly substantial assemblages from two Anglo-Scandinavian pits. Although this material has been the subject of an assessment, not a full analysis, the results are sufficient to be incorporated into this synthesis (Carrott et al. 1998). Further material of Anglo-Scandinavian date has been recovered from excavations on Layerthorpe, where deposits of refuse and leather working debris appear to have accumulated within the channel of the Foss, and a small assemblage from 76–82 Walmgate (1987.33). Further 9th- to 10th-century material has been recovered from excavations in North Street (1993.1), and has been subject to an assessment, not a full record (Dobney and Jaques 1993).

Excavations at 58–9 Skeldergate (1973–5.14) yielded modest bone assemblages, which are reported in *AY*

15/1, 16–19. These assemblages are from 'soil' deposits, and the circumstances of their deposition are not clear. An Anglo-Scandinavian/Norman phase was recognised at 24–30 Tanner Row (i.e. Period 9, 1983–4.32; *AY* 15/2, 68–9), though little material was recovered that is relevant to this synthesis. The material attributed to Period 4a at 46–54 Fishergate (1985–6.9), dated to the first half of the 11th century, is late Anglo-Scandinavian, though the striking thing about this site is the lack of evidence of occupation in the late 9th and 10th centuries.

In short, much rests on Coppergate, with some additional material from elsewhere, not all of it fully recorded. Large though the Coppergate archive is, its predominance means that much of what we think we know about the zooarchaeology of Anglo-Scandinavian York rests on evidence from a few tenements along one street, and the synthesis should be read with that in mind.

Thematic overview

To give structure to this part of the text, the information recovered from York animal bones is reviewed under four headings: animal husbandry; distribution and deposition; fishing and fowling; and pets and pests. These four categories are intended to explore, respectively, the production of staple animal resources, their circulation and utilisation within the city, the acquisition of animal resources beyond the realm of agriculture, and the place of animals in people's homes and lives.

Animal husbandry

Table 20 summarises the abundance of bones of the major taxa in Anglo-Scandinavian assemblages from York discussed in this paper. The predominance of cattle bones is striking; they comprise 59% of all identified hand-collected bones from Periods 3 to 5C at Coppergate (*AY* 15/3, 151, table 40). In Anglo-Scandinavian assemblages from 1–9 Micklegate, cattle comprised 61% of identified fragments; 67% and 59% in Trenches 2 and 3 respectively at 9 St Saviourgate; and 72% in the small assemblage from 76–82 Walmgate. Though not fully quantified, cattle bones comprised the majority of Anglo-Scandinavian assemblages from North Street. This predominance of cattle is obviously accentuated by the reliance on hand-collection of bones. For comparison, in samples from Micklegate sieved and sorted to 2mm, cattle comprised only 40% of identified specimens. None the less, the predominance of cattle is too marked to

Table 20 Numbers of identified specimens in hand-collected assemblages from Anglo-Scandinavian deposits. Note that the 'All Anglo-Scan.' category for Coppergate includes material in addition to that allocated to Periods 3 to 5C

	Cattle	Sheep	Pig	Other	Bird	Fish	Total
16–22 Coppergate							
All Anglo-Scan.	31872	11722	6536	1297	2485	108	54020
Period 5C	1095	384	254	22	89	–	1844
Period 5B	7257	2757	2616	181	1050	56	13917
Period 5A	3382	1006	802	103	227	6	5526
Period 4	5541	2645	930	135	426	10	9687
Period 3	2255	606	228	108	62	–	3259
1–9 Micklegate							
All Anglo-Scan	727	149	159	85	51	13	1184
76–82 Walmgate	190	41	17	14	3	–	265
9 St Saviourgate							
Trench 2	141	37	9	20	4	–	211
Trench 3	165	92	19	4	2	–	282

be argued away, and we have to ask what agricultural regime would have produced a surplus of adult cattle.

Dairy production might be expected to generate a death assemblage in which male calves surplus to breeding requirements and elderly cows culled from the dairy herd are most abundant. Calves are infrequent in the York assemblages, though culled calves may have been disposed of on the farm, at point of production, rather than being brought into town, so it might be erroneous to argue from their absence alone. However, even if we propose that calves were disposed of outside the town, the adult cattle seen in York are, on the whole, not particularly old; rather they are mostly adults aged between about three and five or six years, plus some second- and third-year beasts. That seems an unlikely profile for culled dairy cows, which are likely to be much older cows, too old to breed or lactate reliably. Kill-off patterns typical of dairy production clearly can be detected in urban assemblages. Medieval material from Bedern shows exactly the 'calves plus old cows' profile predicted here (*AY* 15/5, 384–7), and a shift towards older cattle detected in the assemblages from 13th-century deposits at Coppergate might also represent an increase in the keeping of dairy cows (ibid.). The material from Bedern stands out from medieval York as a whole, and there are several grounds for believing that this institution derived its cattle and sheep from populations other than those that supplied the rest of the city (*AY* 15/5, 395–7, 409–10). None the less, it serves to show that the mortality profile that might be predicted from a dairy herd *can* be detected in urban debris, and therefore that the absence of that mortality profile in data from for Anglo-Scandinavian York can be used to argue against specialised dairying.

Further afield, Viking-Age and Norse sites in Orkney and the Hebrides typically yield death assemblages in which young calves are abundant (e.g. Bond 1998, 100; Noddle 1997, 235–7). We can be confident, therefore, both that cattle-based dairy production was practised in some parts of the British Isles where there was Scandinavian influence, and that the death assemblages typical of that production can occur at urban sites, as well as at rural sites of production. The evidence does not prove that cattle in the vicinity of York in the Anglo-Scandinavian period were never used as dairy animals, only that this was not the dominant form of agricultural production.

Specialised meat production can probably be ruled out as well. If cattle production were optimised for meat, we would expect a predominance of young adults, killed as their growth rate declined. Assuming that Anglo-Scandinavian cattle grew appreciably more slowly than modern beef cattle, that point might not have been reached until the cattle were two to three years old. On that assumption, we might expect the mortality profile from a beef herd to show a predominance of mandibles in which the third molar was just erupting and coming into wear. Some of the cattle in assemblages at Coppergate and Micklegate were around 18 months to three years old at death, old enough to be full-grown and productive in terms of meat, but only just becoming productive in terms of milk or offspring. However, the great majority were appreciably older, indicating that they were kept as adults for some productive purpose other than meat alone. Fig.98 summarises the age at death data for cattle from Micklegate and Coppergate. In general, the two assemblages are similar in having the great majority of specimens in the subadult and older categories, although there is a higher proportion of elderly cattle (seven to eight years plus) in the Micklegate assemblage. The observed age profiles would have allowed a steady increase in herd size, the adult cattle 'paying back' their grazing with two or three offspring before death. If this was a priority, then it was maintained throughout the Anglo-Scandinavian period: there is no substantial change in the mortality profiles from the late 9th to early 11th centuries. The exceptional preservation of leather artefacts and manufacturing waste at Coppergate serves as a reminder that cattle were important for their hides, too. Hides were clearly used somewhat selectively, as 'calf' leather predominates in artefacts of this period, although the correlation of 'calf' with dental age categories is problematic (*AY* 17/16, 3234–5).

The most plausible interpretation of the age at death data, and the predominance of cattle in Anglo-Scandinavian assemblages, is to suppose that cattle fulfilled a mixed function, probably with the emphasis on maintaining numbers of adults as breeding stock and for haulage of ploughs and carts. Additionally, of course, cattle produce the dung necessary to maintain crop yields. If cattle were important for dung and traction, that implies an appreciable need for tilled fields and therefore for crop production. In the original publication of evidence from Coppergate,

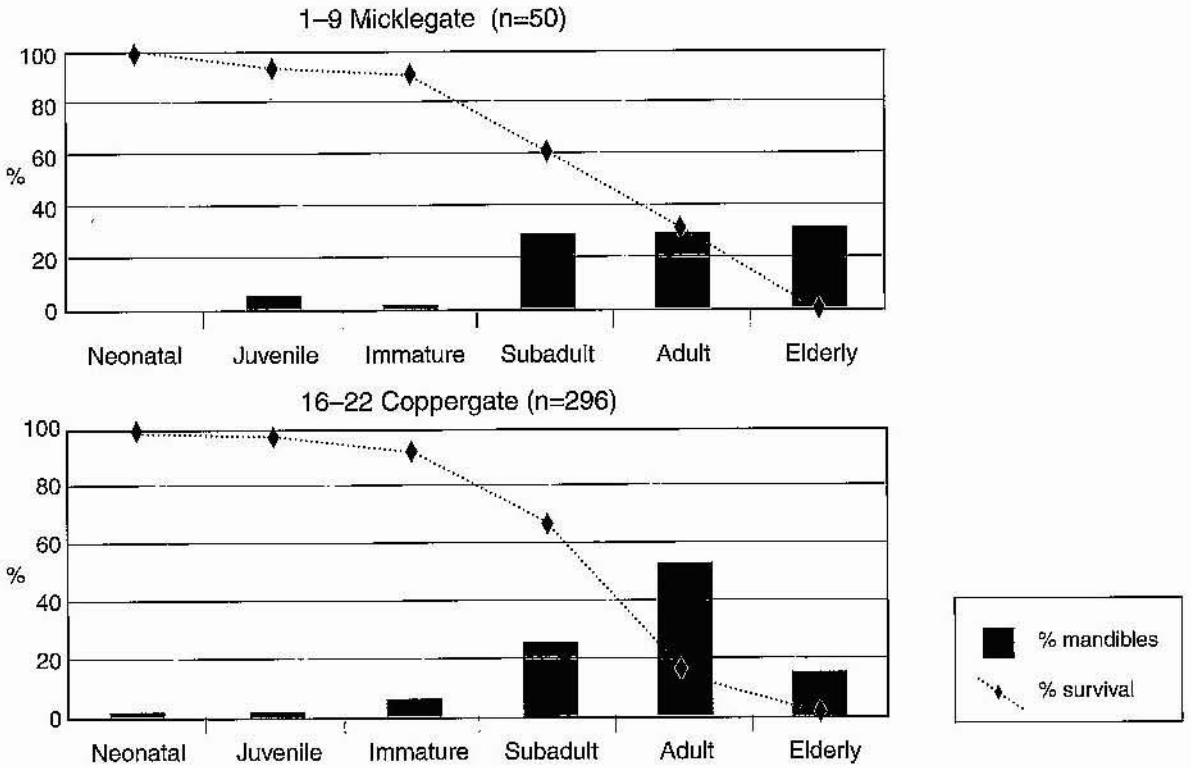

Fig.98 Age at death distribution for cattle from 16–22 Coppergate and 1–9 Micklegate, based on dental eruption and attrition. Age groups are as used and defined in AY 15

the observation was made that this multi-purpose husbandry 'is what might have been predicted for a system based on independent small farmers' (*AY* 15/3, 163). In retrospect, that interpretation is an over-simplification. If renders and other obligations required farmers to provide livestock, or to provide a plough team, both of those obligations would tend to predispose towards the keeping of prime adult cattle, in addition to older working cattle for use on the farm. If our understanding of Anglo-Saxon England from historical sources can be projected into the Anglo-Scandinavian north, it is likely that most, if not all, of those engaged in animal husbandry and farming in general were bondsmen of some form, owing renders and allegiance to a lord. That social and economic stratification need not have precluded the 'private' ownership of livestock by farmers, the husbandry of which would probably have been subject to different objectives than the husbandry of the lord's livestock. A detailed exploration of this subject is beyond the remit of the present chapter, and it is doubtful that historical sources for Anglo-Scandinavian Yorkshire would provide a clear answer. For the present purposes, there are grounds for allowing that some of the movement of livestock into York may have been by direct trade, and some by redistribution. Differences in the bone assemblages from 8th-century Fishergate and late 9th- and 10th-century York have been argued to indicate a shift towards a greater economic independence on the part of the urban population (O'Connor 1994). The likely complexity of the economic context, and the possibility that the Anglo-Scandinavian period saw marked changes in social and economic relations, make it necessary to interpret the urban assemblages with due caution.

Another issue related to animal husbandry is the use of woodland as wood-pasture. The scale of timber construction in Anglo-Scandinavian York makes it quite clear that mature woodland was accessible within a practicable distance. We know little about the management of such woodland (but see Hill 1994), though cattle are well suited to grazing open

woodland, and it is possible that some of York's beef derived from extensively managed 'park' cattle. Studies of plant macrofossils and invertebrate animal remains from Coppergate have produced numerous records of woodland taxa (*AY* 14/7, 656–61), and it is clear that woodland mosses were brought into the city. Moss would offer a ready mode of transportation for seeds and snails, though mud and plant debris attached to cattle would serve equally well as a vector (see pp.389–91). Again, this is a topic that merits further investigation, in part through archaeobotanical work in the region, and in part through historical reference to woodland pasturing.

The place of sheep in this proposed regime is around the edges, as useful grazers of uncultivated rough grassland, and of harvest aftermath. The relative abundance of sheep in Anglo-Scandinavian assemblages is generally low (Table 20): just 22% of identified hand-collected specimens at Coppergate, 13% at Micklegate; 16% at Walmgate; 18% in Trench 2 at St Saviourgate, but 33% in the two pits in Trench 3 at St Saviourgate. Recovery bias does not entirely account for these low percentages: at Micklegate, sheep and sheep/goat specimens comprised 13% of hand-collected assemblages, and 12% of sieved assemblages. Either wool production was relatively unimportant, and finds of textiles and related artefacts suggest otherwise (see pp.474–5), or it took place at a sufficient distance from York that only small numbers of sheep entered the city's food supply. Age at death data consistently show a predominance of adult sheep, though with some site-to-site differences. Fig.99 summarises the attribution of mandibles to age classes for Micklegate and for Coppergate. Taken with the more detailed breakdown of the Coppergate data in *AY* 15/3, 173, table 48, the results show the presence of generally younger sheep at Micklegate (mostly one to two years old) than at Coppergate (mostly two to four years old). Although the two samples differ considerably in size, the difference is highly significant (Table 21). The two sites may have been access-

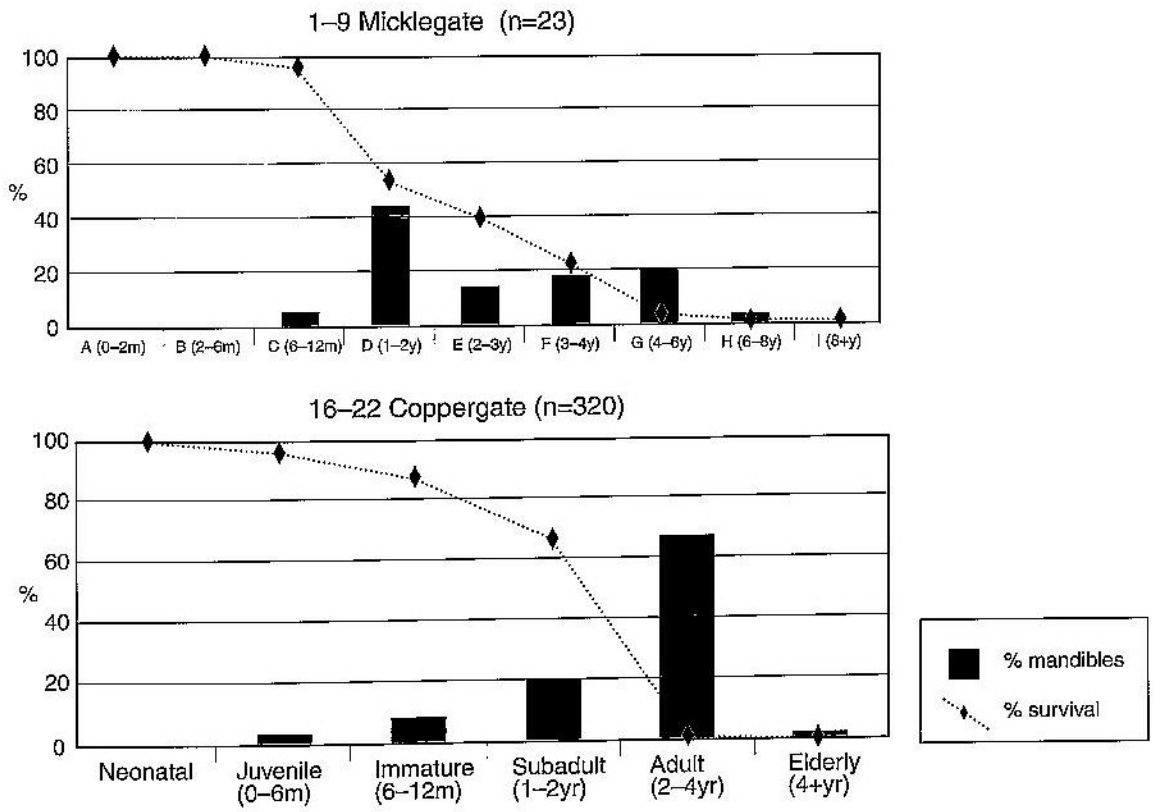

Fig.99 Age at death distribution for sheep from 16–22 Coppergate and 1–9 Micklegate, based on dental eruption and attrition. Age groups for Coppergate are as used and defined in AY 15; those for Micklegate follow Payne. Approximate calendar age equivalents are given to facilitate comparison. See also Table 21, p.432

Table 21 Absolute numbers of sheep mandibles from Anglo-Scandinavian contexts at 16–22 Coppergate and 1–9 Micklegate in broad age classes (see Fig.99). Despite the substantial difference in sample size, the age distributions are significantly different (chi-squared = 45.74; 4 degrees of freedom; $p < 0.01$)

	0–6 months	6–12 months	1–2 years	2–4 years	4 years+	Total
16–22 Coppergate	10	27	64	215	4	320
1–9 Micklegate	0	1	10	7	5	23

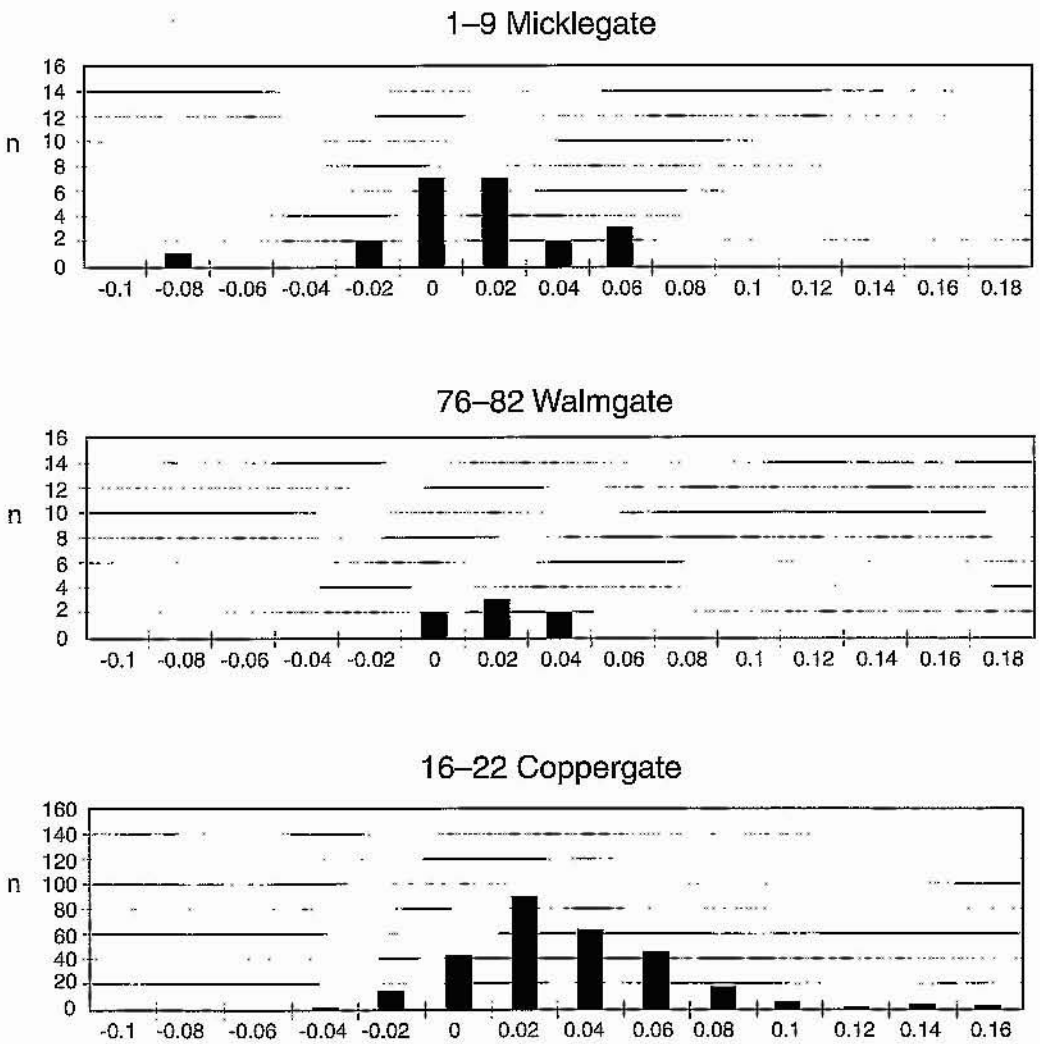

Fig.100 Log-ratio comparisons of the lengths of measurable adult caprine bones from 1–9 Micklegate, 76–82 Walmgate and 16–22 Coppergate, using a modern sample of Shetland ewes as the zero standard

ing different sources, both of them producing adult sheep for mixed meat and wool production, but with the Micklegate source perhaps tending more towards the provision of prime young adults for meat. That difference could reflect differences between the two neighbourhoods in terms of the rights and obligations of their respective populations, a topic that cannot be addressed through animal bones alone.

There is some tenuous evidence that these sheep were quite diverse in size and appearance. Sheep horncores from Coppergate showed a considerable variation in size and morphology, with no obvious division into 'male' and 'female' forms, perhaps indicating that variation due to sexual dimorphism was exceeded by other phenotypic variation. If sheep came to the city from a number of different sources, between which there was little exchange of livestock, then we might expect to see appreciable variation in the urban sample. Specimens of polycerate (four-horned) sheep have been found at Coppergate and St Saviourgate. In Figs.100–1, size variation in sheep bones from Coppergate, Walmgate and Micklegate is investigated by means of a log-ratio comparison. This procedure makes best use of small datasets, such as that from Walmgate. The standard measures used in this comparison are the means for a sample of modern Shetland ewes given by Davis (1996). The

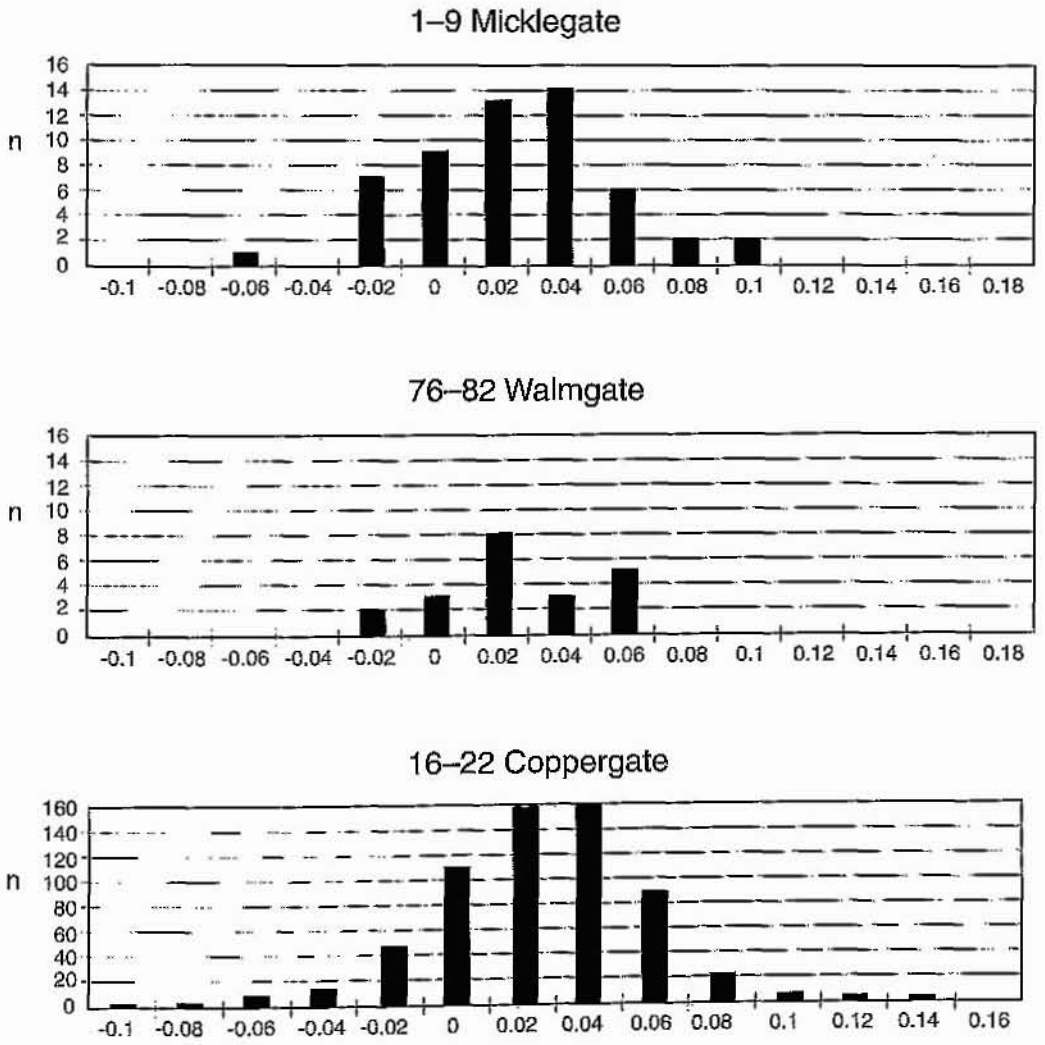

Fig.101 Log-ratio comparisons of the widths of measurable adult caprine bones from 1–9 Micklegate, 76–82 Walmgate and 16–22 Coppergate, using a modern sample of Shetland ewes as the zero standard

comparison on width measurements shows little difference between the samples, but on length measurements, the Coppergate sample shows a slightly higher mode than the sample from Micklegate. A difference in lengths but not breadths could have a number of explanations, amongst them differences in the ratio of males to females in the two samples. Fig.102 compares the sheep metacarpals from the Coppergate sample with the Shetland standards. The Coppergate sample includes quite a number of specimens that are appreciably more long and slender than the Shetland ewes, and it is therefore quite possible that these specimens are wethers (castrated males). Comparison with the Shetland specimens does not *prove* that the Coppergate specimens are, case by case, male or female. However, the results shown in Fig.102 would be consistent with a high proportion of wethers in the Coppergate sample. As the sample consists of fully fused metacarpals, it represents sheep older than about one-and-a-half years.

That inference takes us back to the question of husbandry regimes. Taking the differences between Coppergate and Micklegate in bone morphology shown in Figs.100–1 and in age at death distribution shown in Table 21, we might wonder whether the higher proportion of second-year sheep in the Micklegate sample were disproportionately ewes. If so, that would account for the less elongated bone morphology seen in the Micklegate sample. That interpretation is not implausible, if an aim of sheep husbandry around York was to raise wool, and there was no particular pressure to increase the size or number of flocks. In that case, some young ewes might have been disposed of as surplus to breeding requirements in their second year, their metacarpals having just fused. They would have yielded their first and best clip of wool, leaving the majority of grazing land to the more productive wethers. The wethers would then have been gradually culled in their third and fourth years, having given two or three clips of wool, and with their wool yield and quality beginning to decline. That interpretation rests on a little evidence and a lot of supposition, but is open to testing as and when more evidence becomes available on the sex and age structure of sheep samples from York. Whether we should expect the expanding population of York and an increased demand for wool and cloth to have an effect on the mortality profiles is debatable. Wool is readily transportable, and any

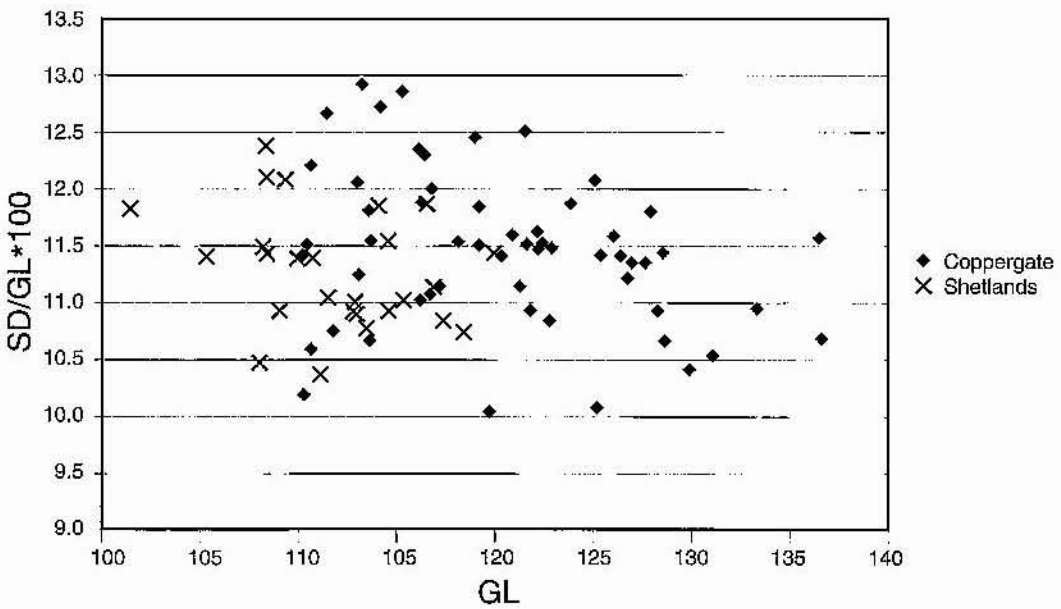

Fig.102 Scattergram of length against an index of relative shaft breadth for sheep metacarpals from 16–22 Coppergate, plotted against a sample of modern Shetland ewes

increased demand generated by York might more readily have been met by trading in wool from further afield, rather than by increasing the numbers of sheep kept in the immediate vicinity of the city.

Pigs might have been kept around the city in small numbers. The relative abundance of pig bones (Table 20) is generally higher at sites where house structures indicate dense occupation (Coppergate 12%; Micklegate 15%) than at Walmgate (6%) or St Saviourgate (7%). Some specimens of neonatal pigs have been recovered, indicating the presence of breeding sows, and the irregular attrition noted on the lower first molars of some Coppergate pigs might be symptomatic of stalled pigs chewing sticks and stones out of boredom and frustration. If pigs were part of the urban scene, rather than part of the general agricultural economy, the gradual rise in their relative abundance through the 10th and 11th centuries might reflect changes in the provisioning of the city (O'Connor 1994, 144–5). Whatever their point of origin, most of the pigs were slaughtered during their second year, though with no particular concentration on narrow age-categories, such as was seen in Anglian material from Fishergate (*AY* 15/4, 249–51), and no evidence of markedly seasonal slaughter.

Distribution and deposition

One of the questions raised above is how far the supply of meat to York was subject to decisions taken by individual urban households or farmers, and how far controlled by a higher social tier such as estate owners or those acting for the regal or ecclesiastical powers. Consistency of butchery practice might be one indicator of central provision, having arisen through the activities of independent specialist butchers, the prototype of the medieval guilds, or because much of the meat supply was managed through slaves or other dependent personnel answerable to a lord or higher power. In fact, there is not much evidence of such consistency at Coppergate or Micklegate, although some 'butchery marks' are seen quite frequently. The longitudinal splitting of long bones was particularly evident in material from North Street, and was the most commonly recorded form of butchery on cattle humeri, radii, femora and tibiae from Coppergate. The cleaving of vertebrae in the median sagittal plane, consistent with the splitting of carcasses into sides, was seen in most samples. In all cattle vertebral centra recorded from Anglo-Scandinavian Coppergate, sagittal cleaving was noted in 166 out of 363 specimens of cervical vertebrae (45·7%), but only 103 out of 564 lumbar vertebrae (18·3%). The difference between those figures probably indicates that some sagittal-plane cutting took place after the carcass had been reduced to a number of large pieces. Subsequent subdivision of the spinal column is shown by transverse cutting in 33·9% (123 out of 363) of cervical vertebrae and 22·9% (129 out of 564) in lumbar vertebrae. It is quite difficult to distinguish the dismantling of carcasses and removal of meat, such as a butcher might undertake, from subsequent chopping of bones to extract marrow or to reduce those bones for the stock-pot, processing that might be domestic. Anglo-Scandinavian York has produced none of the large-scale chopping-up of bones such as is seen in Roman deposits (*AY* 15/2, 82–3). The balance of evidence suggests that there was little central control of distribution and butchering within the city. The butchery evidence shows enough diversity to be consistent with much of it taking place at the household or neighbourhood level, perhaps by whoever had the tools and sufficient expertise.

One deposit (4374) at 9 Blake Street (1975.6), probably of (?late) Anglo-Scandinavian date, gave an assemblage that essentially comprised six cattle skulls, over 30 cattle metapodials, and 50 first phalanges (O'Connor 1986b, 9). Most of the cattle skulls had massive depressed fractures in the frontal region, consistent with a lethal blunt instrument injury. This Blake Street assemblage is evidently a deposit of primary butchery waste. A generally similar, but less restricted, assemblage was recovered from pit 3007 at 9 St Saviourgate. Otherwise, Anglo-Scandinavian York shows little indication of selective disposal of bone debris. Coppergate and Micklegate had bones in pits, bones trodden into surface dumps of refuse and bones in levelling deposits under structures. Even contexts closely associated with structures at these two sites contained cattle cranial and foot bones. It appears that the debris from different stages of carcass reduction was usually disposed of rather unsystematically into whatever dumps or holes in the ground happened to be available at the time. Apart from the isolated examples described above, we have little positive evidence of selective deposits of, for example, skulls and feet, or the negative evidence of assemblages conspicuously depleted of heads and feet. What that might indicate is that heads and feet were not regarded as 'waste' at the original point of butchery.

An interesting example of the butchering of pigs comes from Period 5B deposits in Tenement B at Coppergate. Pig bones from floor and backfill deposits in Structure 5/3 show a particularly high proportion of foot bones, whereas the admittedly quite small sample of pig bones from the adjacent Structure 5/4 is markedly depleted in head and foot bones, with abundant bones from the legs and limb girdles (*AY* 15/3, 179–80). To put that into percentages, 3rd and 4th metapodials made up 67% of pig limb and girdle elements from Structure 5/3 deposits, but only 15% in Structure 5/4. The assemblages from the two Structures are almost complementary, and the deposits concerned appear to have sampled the systematic butchering of several dozen pigs, though whether in one event or several closely spaced events it is not possible to say.

Apart from the unfortunate pigs of Tenement B, it appears that debris from primary butchery at Coppergate and at Micklegate became re-acquainted with household debris, and therefore that bones were distributed with meat and so perceived as having either food or other value. Many cattle long bones have been chopped roughly to open up the marrow cavity, also indicating the food value of the bones. A point to watch for in subsequent work on Anglo-Scandinavian sites in York might be the presence of butchered cattle cranial and foot bones in unambiguously domestic waste contexts, necessitating context-by-context assessment of bone assemblages closely associated with domestic structures. Such associations certainly seem to have occurred at Coppergate, and arguably at Micklegate. If confirmed elsewhere, they would point to quite an intensive utilisation of cattle carcasses, not necessarily through a desperate need for meat but perhaps because of a cultural inclination to maximise the use of a carcass.

One value of bone is as raw material for artefacts (see pp.469–72). There is some antler working debris from Coppergate, Micklegate and North Street, though not on the scale seen in some contexts at Fishergate and at Clifford Street (*AY* 17/12), and no evidence of antler working at St Saviourgate. The small assemblage from Walmgate included five fragments of worked red deer antler. Apart from antler, bone *per se* is well represented in artefacts, including a lot of objects made from unspecified mammalian compact bone. These objects are typically pins or other elongated objects cut from thick, flat, straight pieces of bone. The bones concerned could be cattle or horse, probably metapodial or tibia shafts. Pig bones are commonly represented amongst the artefacts, both as 'needles' fabricated from fibulae, and as 'toggles' made from metapodials. These artefacts illustrate the extent to which bones were put to use. Taken with the butchery evidence, they show that cattle carcasses, especially, were used down to the last gasp.

Fishing and fowling

Bird and fish bones from Coppergate were the subject of special studies by E.P. Allison and A.K.G. Jones respectively, and particular attention was paid to their recovery. As a consequence, the very large volume of fish and bird material from this one site tends to dominate the record for Anglo-Scandinavian York as a whole. The results from Micklegate are generally consistent with those from Coppergate, and other Anglo-Scandinavian deposits have yielded insufficient material to make any useful comparison. Table 22 gives a full list of bird taxa identified from Anglo-Scandinavian deposits in York.

The birds show the familiar mixture of domestic taxa (chickens, geese), presumably hunted wild taxa (e.g. waders, crane, wild geese and ducks, black grouse), urban taxa (e.g. corvids), and 'accidental' taxa that fit none of these categories (e.g. short-eared owl). The hunted taxa show a predominance of those that form large flocks in winter on wetland areas. Although the identification of duck and goose bones to species is problematic, some species have been identified with due caution that are likely to have been winter visitors only, such as barnacle goose and teal. The washlands ('ings') of the Ouse and Derwent valleys are close enough to York for those taxa to have been hunted directly by York people, though this assumes that distance from York was the only parameter determining accessibility. A notable exception are the auk species that first appear late in the Anglo-Scandinavian record for Coppergate, and become a distinctive feature of 11th- and 12th-century assemblages in York and Beverley. Guillemots and razorbills are maritime taxa, coming ashore to breed in colonies, and the specimens recovered from York were probably acquired by trade with the east coast.

Both the frequency and the occasional abundance of corvid taxa, notably jackdaw and raven, are consistent with the evidence that Anglo-Scandinavian

Table 22 A list of the bird species identified from Anglo-Scandinavian deposits at 16–22 Coppergate and 1–9 Micklegate. The list excludes higher-level taxa. Other sites of this date in York have produced only domestic fowl and goose bones

		Coppergate	Micklegate
Mute swan	*Cygnus olor*	*	
Whooper swan	*Cygnus cygnus*	*	
Pink-footed goose	*Anser brachyrhynchus*	*	
White-fronted goose	*Anser albifrons*	*	
Domestic/greylag goose	*Anser anser*	*	*
Barnacle goose	*Branta leucopsis*	*	*
Brent goose	*Branta bernicla*	*	
Mallard	*Anas platyrhynchos*	*	
Teal	*Anas crecca*	*	
Tufted duck	*Aythya fuligula*	*	
White-tailed eagle	*Haliaectus albicilla*	*	
Red kite	*Milvus milvus*	*	
Buzzard	*Buteo buteo*	*	
Goshawk	*Accipiter gentilis*	*	
Sparrowhawk	*Accipiter nisus*	*	
Black grouse	*Lyrurus tetrix*	*	
Domestic fowl	*Gallus gallus*	*	*
Coot	*Fulica atra*	*	
Crane	*Grus grus*	*	*
Golden plover	*Pluvialis apricaria*	*	
Grey plover	*Pluvialis squatarola*	*	
Woodcock	*Scolopax rusticula*	*	
Guillemot	*Uria aalge*	*	
Razorbill	*Alca torda*	*	
Short-eared owl	*Asio flammeus*	*	
Rock/Stock dove	*Columba livia/C. oenas*	*	*
Wood pigeon	*Columba palumbus*	*	
Jackdaw	*Corvus monedula*	*	
Raven	*Corvus corax*	*	

York provided ample opportunities for scavengers. The importance of organic refuse in urban food webs, and thus in the urban environment, has been discussed at length elsewhere (O'Connor 2000b). The refuse accumulations that became the thick, richly organic deposits typical of the archaeology of this period probably did much to determine the characteristics of the urban biota, from the numerous flies and beetles to the scavenging white-tailed eagles.

The fish tell a number of stories, and Table 23 lists the taxa identified from Anglo-Scandinavian samples. Assessment of the relative abundance of fish taxa is problematic because different taxa differ appreciably in the number of bones in the skeleton, or in the proportion of those bones that can be confidently identified, a point that is discussed further in *AY* 15/5 (pp.398–401). Accordingly, the abundance data discussed here refer to the recorded assemblages of bones and should not be directly equated with the relative abundance of fish. Furthermore, this analysis takes account only of changes of relative abundance of such magnitude that anatomical biases alone are an insufficient explanation. That said, the assemblages from Coppergate are dominated by eel bones. Through the 10th century, there is a marked rise in the relative abundance and relative frequency of herring, and subsequently of offshore marine taxa, notably cod and other gadid species (*AY* 15/3, 195–8). In 10th- to early 11th-century deposits at Micklegate,

Table 23 List of fish taxa identified from Anglo-Scandinavian samples from 16–22 Coppergate and 1–9 Micklegate. Some identifications to Family have been omitted, and '?' records are only included if that species has not been positively identified from the same site

		Coppergate	Micklegate
Thornback ray	*Raja clavata*	*	
Sturgeon	*Acipenser sturio*	*	
Shad	*Alosa* sp(p).	*	*
?Sprat	*?Sprattus sprattus*	*	
Herring	*Clupea harengus*	*	*
Grayling	*Thymallus thymallus*	*	
Salmon	*Salmo salar*	*	*
Trout	*Salmo trutta*	*	
Smelt	*Osmerus eperlanus*	*	*
Pike	*Esox lucius*	*	*
Carp family	Cyprinidae	*	*
Barbel	*Barbus barbus*	*	
?Gudgeon	*?Gobio gobio*	*	
?Tench	*?Tinca tinca*	*	
?Bream	*?Abramis brama*	*	
Roach	*Rutilus rutilus*	*	*
?Rudd	*?Scardinius erythropthalmus*	*	
Chub	*Leuciscus cephalus*	*	
Dace	*Leuciscus leuciscus*	*	*
Eel	*Anguilla anguilla*	*	*
Whiting	*Merlangius merlangus*	*	*
Cod	*Gadus morhua*	*	*
Saithe	*Pollachius virens*		*
Haddock	*Melanogrammus aeglefinus*	*	
Burbot	*Lota lota*	*	
Sand eel	*Ammodytes tobianus*		*
Perch	*Perca fluviatilis*	*	*
Horse mackerel	*Trachurus trachurus*	*	
Mackerel	*Scomber scombrus*	*	*
3-spined stickleback	*Gasterosteus aculeatus*	*	
Flatfish	Pleuronectidae	*	*
Flounder	*Platichthys flesus*	*	

herring bones outnumbered those of eel, with the next taxon (cod) only one-tenth as abundant as eel. There would appear to be some variation in the deposition of fish bones from site to site, therefore. The change seen through the 10th century at Coppergate seems to show an extension of the area fished from York, from the lower reaches of the Ouse, into the Humber basin, then into North Sea inshore waters. Deeper-water marine fish, such as ling, haddock and conger eel, only become a regular feature of York assemblages from the 12th century onwards (e.g. see *AY* 15/4, 263–7). Apart from eels, river fish are represented mostly by pike and cyprinids, the latter often not identifiable beyond the level of Family, and these taxa are most abundant in late 9th- to early 10th-century assemblages. Two estuarine taxa of note are shad, present in late 9th-century samples from Coppergate and from Micklegate, and smelt. The latter species was present in Micklegate samples, and, though never particularly abundant at Coppergate, occurred in an appreciable number of samples, particularly from the earlier part of the 10th century.

The early Anglo-Scandinavian assemblages from Coppergate are also typified by the frequent, though never particularly abundant, presence of barbel, bur-

bot and grayling, species that require well-oxygenated water with little suspended sediment. The low relative abundance of these taxa is at least in part a consequence of the anatomical effects outlined above, and their frequency is probably a more useful parameter to consider (see O'Connor 2001a for further discussion of quantification of sieved assemblages). From the mid-10th century onwards, they become less frequent, and disappear from the record by the end of the Anglo-Scandinavian period. Changes in relative abundance could be an arithmetical consequence of changes in the relative abundance of other taxa, the data being interdependent. However, the disappearance of certain freshwater taxa from deposits in which fish bones are otherwise well represented requires another explanation. Assuming for the moment that these fish are from the Ouse-Foss system, we might infer from their presence and absence an increasing pollution of the rivers around York as the settlement grew. The deposition of refuse into the rivers, coupled with increased sediment input through run-off from unvegetated and unstable road and backyard surfaces, could have led to a rise in suspended sediment and a fall in the oxygen content of the water. In parallel with the decline in 'clean water' fish, the hand-collected freshwater molluscs from Coppergate show a decline in the freshwater mussel *Unio tumidus* and a rise in *U. pictorum* (*AY* 14/7, 780). Modern data indicate that *U. pictorum* is the more tolerant of silty, poorly oxygenated water, so the freshwater mussels are consistent with the inferences drawn from the fish bones (see p.391). Furthermore, the simple comparison of counts of valves of two mollusc taxa does not suffer from the arithmetical and anatomical uncertainties attendant on the fish bones.

Although river pollution remains the most credible explanation of the observed data, two other possibilities should be considered, as neither can be absolutely ruled out at this point. The first is a base-level change in the Ouse-Foss system, reducing the gradient of the river and effectively moving the 'grayling zone' upstream from York. On this model, grayling, barbel and burbot would have become unavailable in the immediate vicinity of York, their place being taken by cyprinid taxa typical of more 'downstream' stretches of lowland rivers. To test this possibility, we need well-dated river levels at York or indirect evidence such as the sequential raising of riverside structures. The second possibility is that the change in the fish recovered from York marks a change in the river systems that were routinely fished. If the Derwent contributed to York's supply of freshwater fish early in the 10th century, but not later, then much the same change in 'clean water' taxa might be apparent in the data. We might think that an implausible explanation, but it cannot be ruled out on evidential grounds, and would be difficult to test directly.

Pets and pests

Amongst the animal bones from sites in York are the remains of those species with which people most intimately shared their lives, voluntarily or otherwise. Dogs are a frequent find, and Anglo-Scandinavian dogs from York show some variation in size and build. The very small 'lap-dogs' seen in Roman assemblages are not known from the Anglo-Scandinavian town, though Fig.103 shows a group of quite small dogs, around 35cm in shoulder height. A larger group is represented by specimens around the size of a modern Border Collie (shoulder height around 55cm). A few specimens defy confident identification as dog or wolf: a tibia and two metapodials from Coppergate are from animals that could be either species. On Fig.103, those three specimens are around the size of a modern Alsatian. Given that recent biomolecular studies have thrown doubt on the species distinction of dog and Eurasian grey wolf (Tsuda et al. 1997), our inability to classify an isolated bone as one or the other is hardly significant. There were some very large canids around Anglo-Scandinavian York; whether they were big dogs, captive wolves, tame wolves or dog/wolf hybrids can not be determined from the bones alone. What can be said is that the great majority of the dog bones were those of adults, and furthermore that sufficient whole or part-skeletons have been recovered to indicate at least the occasional deliberate burial of dogs. These two observations would seem to indicate that dogs were cared for and treated differently to the more utilitarian animals. Very little pathology was noted on the dog bones. One specimen showed marks of butchery: a fragment of occipital bone that had been cut away from the anterior part of the skull.

Bones of cats have been recovered quite frequently from Anglo-Scandinavian deposits, though seldom in any abundance, and generally as dispersed bones rather than skeletons. Furthermore, quite a high proportion are of subadult cats, an observation that has been made in other urban contexts (O'Connor 1992; 2000b). The high subadult mortality and lack of evi-

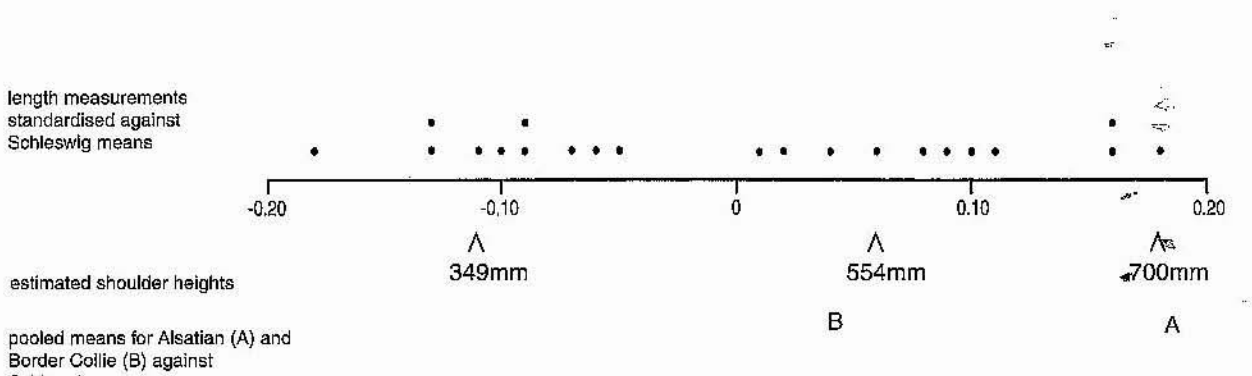

Fig.103 Length measurements of dog bones from Anglo-Scandinavian Coppergate, plotted as log-ratio values, taking the sample means of dog measurements from medieval Schleswig as the zero standard (Spahn 1986). Pooled values for a modern Border Collie (B) and a modern Alsatian (A) are given, with shoulder heights reconstructed from three of the Coppergate specimens using the regression equations given by Harcourt (1974)

dence for careful disposal point to cats occupying a different role to that of dogs, and the evidence is more consistent with a largely feral population of cats than with 'pet' cats under close management and care. Several cat skulls and mandibles from Anglo-Scandinavian deposits at Coppergate, Micklegate and St Saviourgate bear fine knife-cuts consistent with skinning, and sieved samples from Coppergate Periods 4 and 5 included concentrations of cat phalanges, such as might have been retained on a pelt. This need only indicate the occasional, opportunistic use of cat skins. If cats were more systematically exploited for their skins, as some colleagues have suggested (McCormick 1997), then we might expect to have found greater concentrations of cat bones (i.e. less frequent; occasionally abundant), such as the deposit reported recently from Cambridge (Luff and Moreno Garcia 1995). An interesting comparison is with Birka. Phases 6, 7 and 8 at this site (approximately late 9th to late 10th century) yielded numerous bones of animals apparently taken for their fur, but whereas foxes, martens and squirrels were largely represented by skull and foot bones, cats were represented by all parts of the skeleton, with no knife cuts noted on the skulls, leading Wigh (2001, 119–20) to conclude that the cats were not systematically skinned.

A general survey of the frequency of taxa across the Anglo-Scandinavian deposits at Coppergate (Scott 1984) showed that cat bones were significantly more frequent in Period 4 and 5 deposits in Tenements A and B than in the same periods in the other tenements. This distribution could be interpreted in either of two apparently conflicting ways. If we accept the evidence that cats lived in Anglo-Scandinavian York largely as feral animals, then the distribution of their bones might indicate that Tenements A and B were less consistently and intensively occupied by people than the other tenements, thus allowing at least some periods of time during which feral cats could move in, breed and die. Conversely, the opposite suggestion has been made, that cats are an indicator of 'hearth and home', and thus that Tenements A and B were the more consistently domestic part of the site (*AY* 15/3, 186). For the moment, the mortality and taphonomic evidence is more consistent with feral cats than with 'pet' cats, and so with Tenements A and B being the part of the Coppergate site where those populations were more common. That assumes, of course, that the distribution of dead cats indicates the distribution of live ones, but as cats appear not to have been eaten, and to have been used for fur rather intermittently, we have no good reason to posit any consistent spatial translocation between life, death and burial.

Anglo-Scandinavian York had rats and mice. Bones recovered by sieving confirm the presence of black rat (ship rat) at Micklegate and from the end of the 9th century onwards at Coppergate, the species having been present in Roman York, but absent from 8th- to early 9th-century occupation at Fishergate. House mice appear to have been in York from the late 2nd century onwards, apparently without a break. The relative frequency of the two species differs consistently at most sites in York where both are present, with house mouse generally at a much higher relative frequency than black rat. In all Anglo-

Scandinavian samples from Coppergate, house mouse was identified in 64 out of 234 samples, giving a relative frequency of 0·27, compared with 0·08 for black rat (19 out of 234 samples). To consider that in more detail, rat bones were generally more common in samples from the 'back' of the site, away from the street frontage, or from Period 3 deposits, before the development of structures and tenements that came to characterise the site in Periods 4 and 5 (Fig.104). This could be taken to indicate an avoidance by rats of the most intensively occupied parts of the site, though the predation of rats by cats, and consequent deposition of rat corpses away from the life-range of the rats, could complicate this interpretation.

Work to date on the remains of small vertebrates other than fish has focused on the interpretation of small bone assemblages in terms of the urban environment. In order for such interpretations to be credible, it is essential to understand the taphonomic pathways by which the remains of mice, frogs and so on have entered pit fills and surface accumulations of refuse. Sieved assemblages from Micklegate formed a pilot study to determine whether the surface condition of small bones in pit fills could be used to differentiate those that accumulated through small animals becoming trapped in pits from those in which small bones were secondarily deposited with refuse or other materials. The results from Micklegate showed that secondary deposition was common, and therefore that the small vertebrates did not necessarily reflect the environment immediately around the pit in question (Piper and O'Connor 2001). Furthermore, it appeared that downward vertical movement of bones had occurred in some deposits, and therefore that at least some accumulations of small bones might not indicate an original accumulation of small vertebrate corpses. In short, our interpretations to date of small bones from sites such as Coppergate have been called into question.

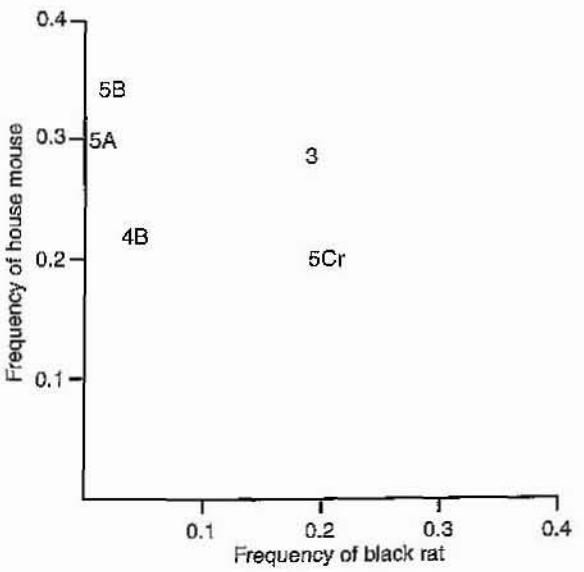

Fig.104 Relative frequency of bones of house mouse and black rat in samples from 16–22 Coppergate. Rats were more frequent early in the Anglo-Scandinavian sequence (Period 3) or at the 'back' of the site (Period 5Cr), in contrast to the frequency of house mice. Note that these are relative frequency data, and therefore independent. The apparent negative correlation is not a statistical artefact

The presence of quite large numbers of frog bones in the fills of some Coppergate pits had been taken to indicate that frogs lived, perhaps even bred, in water-filled pits that, by inference, must have lain open for some months at least. However, the Micklegate study indicates that two taphonomic mechanisms might be operating. The first is the secondary deposition into pits of refuse that had accumulated elsewhere, and had been used by frogs as a place in which to hibernate or as a place of shade and moisture in summer, leading to the secondary deposition of frog corpses into the pit. The second is the post-depositional concentration of small bones by downward movement. The richly organic deposits that are typical of this period appear to be far too dense and coherent to allow such movement. However, that is their texture and porosity when excavated. As originally laid down, these deposits probably included quite substantial lumps of organic material, and could have been essentially clast-supported, with large pore spaces through which small bones could have been moved by gravity and water. The downward movement of bones would have ceased at the interface with less porous, matrix-supported, mineral sediments, hence the concentrations of small bones at the base of pits, or towards the base of organic fills that are underlain by deposits composed largely of silts and clays (*AY* 19/2, 207–10). Secondarily redeposited assemblages of frog bones, in particular, can be distinguished from primary deposits of frogs by the differential loss of fragile skeletal elements, notably the parasphenoid, and by the dispersal of elements of single individuals. In short, the interpretation of small vertebrate assemblages from sites such as

Micklegate and Coppergate is both more difficult and more interesting than has previously been allowed, and should be approached with some caution until the taphonomic processes involved are better understood. Research continues on this subject. Early results indicate that assemblages of small bones from pits at different sites in York have quite different taphonomic trajectories, requiring site-by-site, or even pit-by-pit, interpretation.

Regional comparisons

Crude comparisons of relative abundance have, of necessity, to be conducted with caution, not least because of the interdependence of the data. Inter-observer variation in the process of identification and recording will lead to inter-site variation that has nothing to do with animal husbandry or deposition. Different depositional contexts will tend to predominate at different sites, too, possibly leading to further variation in the data if some taxa are more likely to have been deposited in, for example, pit fills than in extensive surface dumps. We can only make such comparisons in very general terms, but even those generalities might be informative if they enable us to recognise, for example, major geographical or cultural trends.

Table 24 compares the relative abundance of major taxa at a range of 8th- to 11th-century sites across north-west Europe. Not all of these sites have a Scandinavian component, and the nature of the sites varies from urban settlement at York, Lincoln and Hedeby (Viking-Age Denmark), to high-status farmsteads at Eketorp III (Öland, Sweden) and North Elmham Park, Norfolk. Some Middle Saxon sites are included, to give a 'pre-Viking' comparandum for the English material, and a group of eastern European 'Slavic' sites is included to allow the examination of geographical trends beyond the sphere of Scandinavian influence.

The first point to make is that a modest predominance of cattle bones — about 40–50% cattle — typifies most of the Anglo-Scandinavian sites, and the Middle Saxon assemblages from early towns. Exceptions to this generalisation are Anglo-Scandinavian York, with around 60% cattle, and three of the East Anglian sites (North Elmham Park, Brandon, Wicken Bonhunt) with a predominance of either sheep or pig. The figures for Brandon and North Elmham Park are quite similar, and probably reflect the high-status role of these two rural sites. Wicken Bonhunt stands out for its high proportion of pigs, unparalleled in Britain, and probably indicating a specialised function for this enigmatic site. Otherwise, the relative abundance of taxa seen in Late Saxon and Anglo-Scandinavian assemblages is a continuation of that seen in Middle Saxon towns, the predominance of cattle being somewhat greater at York. Widening the comparison, York is in a '60%+ cattle' group that includes the two 'Viking' towns in Ireland, and one early town in the Netherlands. As Deventer cannot be argued to have been particularly 'Scandinavian', the predominance of cattle at these sites may have more to do with a similarity in their function as regional centres for trade and exchange than with any cultural affiliations.

The two Orkney sites in Table 24 show much the same spectrum of relative abundance, with cattle the most numerous taxon, but not heavily predominant. What the simple bone counts conceal is a major difference between the utilisation of cattle in the Northern Isles and in mainland Britain at this time. In the Anglo-Scandinavian assemblages, and at Waterford and Dublin, the great majority of cattle remains in the towns were from adults, with small numbers of one- and two-year-old individuals. At Skaill and Buckquoy, and in other assemblages from Orkney and Shetland, a high proportion of the cattle are immature, young calves apparently slaughtered as part of a dairying strategy. This is not a distinctively 'Viking' strategy, but a continuation of a husbandry regime that has its roots arguably in the Middle Iron Age in Orkney and Shetland.

What these data seem to show, to apply a sweeping generalisation, is that Viking-Age subsistence throughout north-western Europe shows some adaptation to pre-existing economic strategies, though with something of a tendency towards cattle husbandry. The high proportions of cattle at the Irish sites should be seen against the predominance of cattle at Early Christian sites in the same region, and the well-attested importance of cattle in Irish life throughout the first millennium AD (Lucas 1989). In York, the one substantial Middle Saxon assemblage, from Fishergate, included over 60% cattle (*AY* 15/4, 236–7), so the predominance at Coppergate and Micklegate could be seen as a continuation of local practices.

Table 24 Summary of the percent relative abundance of major taxa in 8th- to 11th-century assemblages from north-western Europe. Note that not all sources have quantified bird and fish bones, and that the sample sizes vary considerably. These percentages should only be directly compared with considerable caution. 'OM' is all other mammals; * indicates that the taxon was not included in the published data

	Cattle	Sheep	Pig	OM	Fish	Bird	N frags
Anglo-Scandinavian and Late Saxon							
16–22 Coppergate (*AY* 15/3, 151) All Anglo-Scandinavian	59.0	21.7	12.1	1.8	0.2	4.6	54020
1–9 Micklegate All Anglo-Scandinavian	61.4	12.6	13.4	7.2	1.1	4.3	1184
Flaxengate, Lincoln (O'Connor 1982) All Anglo-Scandinavian	52.7	27.2	10.4	5.7	0.7	0.7	13104
North Elmham Park II (Noddle 1980) Late 9th–early 11th century	26.9	38.6	21.2	6.3	0.1	7.0	3892
Site 1092, Thetford (Jones 1984) 9th–10th century	38.5	26.1	16.5	6.6	2.8	9.6	2386
Portchester Castle (Grant 1976) Late period, 10th–11th century	40.5	24.6	15.1	8.9	0.2	10.5	2542
'Viking Age' or equivalent Scotland and Ireland							
Skaill, Orkney (Noddle 1997) 9th–10th century century	45.7	37.6	11.6	5.2	*	*	6024
Buckquoy, Orkney (Noddle 1978) 9th–10th century	43.1	26.8	14.4	6.6	4.3	4.7	3236
Waterford (McCormick 1997) Late 11th–early 12th century 12th century	53.1 61.5	19.8 17.0	23.7 17.2	3.3 4.3	* *	* *	1891 2594
Dublin, Fishamble Street (McCormick 1982) 10th century	74.3	19.5	5.1	0.8	*	*	1927
Middle Saxon England							
Melbourne Street, Southampton (Bourdillon and Coy 1980) 8th–9th century	49.5	30.0	14.4	1.0	2.7	2.5	48258
Brandon (Crabtree 1996) 8th–9th century	26.1	47.8	17.7	2.2	*	6.2	51478
Wicken Bonhunt (Crabtree 1996) 8th–9th century	14.4	10.8	58.5	1.3	*	15.1	35800
Ipswich (Crabtree 1996) Late 7th–9th century	41.4	20.8	30.0	1.8	*	6.3	10426
Peabody site, London (West 1993a) Late 7th–9th century	45.1	22.0	28.9	1.1	0.0	2.8	5077
Maiden Lane, London (West 1993b) Late 7th–9th century	52.3	15.4	27.9	1.6	*	2.8	5537
Mainland north-western Europe							
Deventer (Ijzereef and Laarman 1986) 10th–12th century	61.9	12.7	22.6	2.9	*	*	700
Ribe (Hatting 1991) 8th century	51.1	18.8	25.0	3.7	0.2	1.1	6102
Birka (Ericson et al. 1988) 9th–10th century	38.1	16.0	34.2	0.9	10.8	3.3	11750
(Wigh 2001) Phase 6 AD 860–900 Phase 7 900–930/940 Phase 8 mid 10th century	33.7 39.3 36.4	18.1 14.5 15.5	41.4 39.2 42.5	6.8 7.1 5.6	* * *	* * *	4094 3486 2949

Table 24 (*contd*)

	Cattle	Sheep	Pig	OM	Fish	Bird	N frags
Hedeby (Reichstein and Thiessen 1974) Late 9th–early 11th century	47.3	14.3	37.1	0.7	*	0.6	29772
Eketorp (Boessneck et al. 1979) 10th–11th century	32.1	49.2	13.5	3.8	0.4	1.0	210548
'Slavic' Eastern Europe							
Cositz (Muller 1985) 8th–10th century	29.3	29.1	31.6	6.5	0.1	3.5	1955
Menzlin (Benecke 1988) 9th–10th century	30.0	9.5	55.4	1.9	*	3.2	29567
Arkona, phase 1 (Muller 1980) 9th–10th century	21.3	33.6	37.3	1.5	1.3	5.1	3200
Oldenburg, horizont 3–5 (Prummel 1991) 10th century	29.8	17.0	46.2	3.0	0.0	4.0	15980
Mecklenburg (Muller 1984) 10th–11th century	22.0	13.7	53.5	4.1	*	6.8	8054
Schonfeld (Teichert 1985) 11th–12th century	50.3	15.9	23.4	8.5	*	1.9	517

Moving eastwards, the continental examples are marked by an increasing relative abundance of pig bones. This is most marked in the 'Slavic' sites, with the exception of the small sample from Schonfeld, but can be seen to a lesser extent at Hedeby and Birka. Eketorp III, with its abundance of sheep, is an exception to the trend, a high-status rural site that stands out in much the same way as Brandon and North Elmham Park. Wigh (2001, 102) cites mostly unpublished data from sites in Sweden to show that a high proportion of pigs is seen in towns such as Birka and Sigtuna, and at several 'aristocratic manor' sites, though not at all rural sites of this date. Pigs are relatively uncommon in the small assemblages from Lingnare A (10th century) and Paviken (9th–10th century). Those exceptions aside, the greater abundance of pigs in more easterly sites is quite a distinct trend, and seems to continue across any nominal eastern boundary of 'Scandinavian' influence into the 'Slavic' region. The comparatively high relative abundance of pigs at Birka and Hedeby may therefore reflect regional trends in husbandry regimes, which in turn were probably a reflection of large-scale environmental zonation.

One means of isolating a distinctively 'Scandinavian' animal husbandry regime might be to examine the regime that was transported to newly colonised lands in the North Atlantic region. Amorosi (1991) provides a summary of data from sites in Iceland. Whether or not Iceland was completely unoccupied at the time of the first Scandinavian settlement, there would not have been an in situ husbandry tradition to which to adapt. Amorosi shows that the earliest settlements, representing the *landnam* period from AD 860 to about 930, have yielded assemblages in which bird bones predominate, indicating highly targeted wildfowling, presumably while the first herds and flocks were established. The domestic mammal bones are mostly cattle, with some caprines (probably mostly sheep) and a few horse bones. These assemblages are most unusual for Iceland. By the Commonwealth period (930 to late 1200s), caprines are overwhelmingly predominant amongst the domestic mammals, with the proportions of birds and fish varying between sites according to local opportunities and needs. Again, there are indications of an initial tendency towards a cattle-based husbandry regime, in this instance rapidly abandoned as the new settlers adapted to conditions in Iceland.

What the regional comparisons appear to show is a capacity to adapt animal husbandry strategies to local traditions and circumstances, and the York data should be seen in that light. A numerical predomi-

nance of cattle, mostly kept to adulthood as multi-purpose edible tractors, was in place in the 8th century. That regime continues through the 9th, 10th and 11th centuries, with some changes in the utilisation of pigs, birds and fish, perhaps reflecting changes in social relations within the city.

Conclusions

The Anglo-Scandinavian period is important in the study of the city's zooarchaeology, not so much because of any outstandingly 'Viking' characteristics as because it is the period in which York was re-established as a major trading and service centre. What we have been able to infer about the husbandry and utilisation of livestock in York shows a general similarity to other sites in the zone of Scandinavian influence, with the differences attributable to pre-existing regional differences in animal husbandry. Further investigation of the Scandinavian connections might focus on the importation of animals, for example, by re-examining some of the accumulations of antler from sites such as Clifford Street specifically for the presence of elk or reindeer. Deer as a whole are represented almost exclusively by antler. We might wonder whether the apparent lack of hunting was dictated by a lack of need, lack of time and personnel, or by the statutory restriction of the right to hunt. We are accustomed to think of exclusive hunting 'forests' as a phenomenon of Norman and later England, but recent research indicates that the arrogation of hunting rights by the social elite can be traced to the Late Saxon period (Naomi Sykes, *in litt.*).

The evidence that carcasses were used intensively is interesting. This appears to have been the case in each of the samples of Anglo-Scandinavian York examined to date, and could be tested in any subsequent excavations without needing particularly large samples. It remains unclear whether the butchering of foot-bones for marrow, for example, indicates a real need to extract all possible food value from a carcass, or whether it was simple custom and practice. Certainly there are few other indications of a food supply under severe strain. The cattle skulls from Blake Street give a hint that deposition of primary butchery waste did sometimes occur in Anglo-Scandinavian York. The lack of butchery apparent on those skulls argues that the generally more intensive butchery was driven by custom rather than need, and was not an invariable practice.

The animal bones have given some indications that York's rivers might have been adversely affected during this period. Obviously, this is not a question that can be addressed through bones alone. Data pertaining to river levels, and evidence of water quality, for example from freshwater molluscs, will be necessary to resolve the interpretation of the changes in the freshwater fish seen in 9th- to 11th-century assemblages. Another topic that requires further data is the question of heterogeneity in livestock during this period. Given some larger samples to compare with the assemblage from Coppergate, it might be possible to test for the presence of different demes of livestock, as has been demonstrated for medieval York (*AY* 15/5). At the moment, even given the material from Micklegate, North Street and other sites, the large size of the Coppergate assemblage means that it predominates in any studies of 9th- and 10th-century livestock from the city and its catchment. The analysis of ancient DNA, for example through analysis of mtDNA haplotypes, is a potential line of investigation of genotype, though heterogeneity in husbandry regime might also become apparent given further material.

It might seem inappropriate to be phrasing these conclusions in terms of the further lines of research that merit investigation. However, the point is that there is still much to be investigated about the zooarchaeology of Anglo-Scandinavian York. Some further research can, and should, be based on further studies of the material to hand, particularly the enormous quantity from Coppergate. However, it is clear that some important questions require the targeted recovery and study of further material from new sites around the city. Even small excavations will yield some useful information, such as confirming the generally intensive use of carcasses or the near-absence of deer, but some lines of investigation, such as spatial variation in sources of livestock, will only be feasible given quite substantial assemblages. This overview has shown that a considerable amount of information has been inferred about the livestock, companion animals, vermin and wildlife of Anglo-Scandinavian York, and the intention has been that it should inform and stimulate further research into a topic which is far from fully investigated.